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SOIL STABILIZATION WITH FLYASH AND SORGHUMWASTE ASH OPTIMIZATION

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ABSTRACT

Adding admixtures at optimum levels to clayey soil using fly ash and Sorghum Waste ash is an effective strategy to prevent the premature failure of structures. The objective of this study is to stabilize a clayey soil with the fly ash and the optimum amount of Sorghum Waste ash. The results are shown below: At 25 % fly ash and optimum SWA of 12%, for a 28 day curing period, the optimum UCS is 994 kPa. At 25 % fly ash and optimum SWA of 12%, the optimum CBR is 6.7 %. At 15 % fly ash, 7% strain the optimum compressive strength is 398 kPa. At 15 % fly ash and optimum SWA of 12%, for a 28 day curing period, the optimum UCS is 604 kPa. At 30 % fly ash, 8% strain the optimum compressive strength is 497 kPa. At 0 % fly ash and optimum SWA of 12%, for a 28 day curing period, the optimum UCS is 501 kPa.

KEYWORDS*: Construction Materials, Clays, Sorghum Waste Ash, Flyash*

Article History

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INTRODUCTION

Clays cause uneven settlements of many structures. Such as Highways[1,2,3]. Permanent deformation accumulates over the design life of pavements. The subgrade factors that lead to premature failures of highways include high clay content, poor compaction, and insufficient drainage.

Adding admixtures at optimum levels to such type of subgrade using fly ash and Sorghum Waste ash is an effective strategy to prevent the premature failure of highways. The objective of this paper is to stabilize soil with the fly ash and Sorghum Waste ash.

MATERIALS

Flyash, Sorghum Waste Ash, and soil were used in this study. A CH soil of the USCS classification was utilized for the research. Class C fly ash constituents are given in Table 1. In this investigation, Sorghum Waste Ash passing through No. 100 sieve (150 micrometers) was used. The chemical composition of Sorghum Waste Ash is shown in Table 2. The Sorghum WA had 50% silica content. This amount provides good pozzolanic action.

EXPERIMENTS

Several simple but valuable tests were conducted to support the importance of this paper. These include the following tests: UCS, CBR, compaction and swell-shrinkage tests.

Compaction

The tests were performed in accordance with ASTM D 1557. The specimens were of 102mm diameter and 116mm height.

UCS

The UCS tests were performed in accordance with ASTM D 2166. The sample sizes were of 40mm diameter and 80mm length.

CBR

The CBR test is an important one used for determining the strength of various layers of pavements. The layers include subgrade soil, subbase, and base course material. The CBR test results can play an instrumental role in the comparison of designed thickness for highways and airfield pavements. The CBR tests were conducted in accordance with ASTM D 1883. The sample sizes were of 152mm diameter and 126mm length.

Swelling

Consolidation test (ASTM D 2435) setup was used for determining the cyclic swell-shrink behavior of the soil. The sample sizes were 76mm and 50mm in diameter and height respectively. The samples were prepared at Proctor's dry densities. The compacted admixture was cured for 14 days and placed over the expansive soil. The efficacy of Sorghum Waste Ash as a cushioning layer between the foundation and subgrade was also tested using the consolidation test.

TEST RESULTS AND DISCUSSIONS

The Influence of fly ash content on the UCS of Sorghum Waste Ash is presented in Figure 1. The influence of fly ash on the stress-strain behavior of the clay specimens in UCS test is shown in Fig. 2. The fly ash content varied from 0 to 30%. When fly ash was increased from 0 % to 25 %, the compressive strength increased from 270 to 437 kPa at a strain of 6%. When fly ash was increased from 0 % to 25 %, the compressive strength increased from 215 to 549 kPa at a strain of 9%.

The influence of Sorghum Waste Ash on CBR of the clay-flyash mix is shown in Fig. 3. At any fly ash content, an addition of Sorghum Waste Ash up to 12% led to increases in CBR. Further increase in Sorghum Waste Ash decreased CBR, indicating that 12% is the optimum value of Sorghum Waste Ash. When the Sorghum Waste Ash content was increased from 0 to 12%, CBR improved from 1.4 to 4.9 for 0% fly ash. When the Sorghum Waste Ash content was increased from 0 to 12%, CBR improved from 2.3 to 6.7 % for 25% fly ash as shown in Figure 3.Low cohesion makes Sorghum Waste Ash a poor cushioning and construction material. However, after stabilizing with fly ash and curing for 28-days, Sorghum Waste Ash acquires better -cushioning properties and hence it can be used as a construction material between the subgrade and foundations.

Fig. 4 shows the influence of a number of cycles on swell percent. Fig. 5 shows the influence of swell reduction layer thickness ratio on percent swells for various surcharges.

At 15% fly ash and 12% Sorghum Waste Ash, for a 28-day curing period, the UCS is 604 kPa as shown in Figure 1. As per Kate and Katti[4], this qualifies as a cushioning material at 15% fly ash. Similar results were found by Sivapulliah et al.[5] for a Sorghum Waste Ash-lime mixture.

References 6 through 17 deal with more research studies on the behavior of clays and admixtures of other waste materials. References 18 through 39 indicate the importance of this research study which is applied in classroom teachings for the benefit of engineering students.

CONCLUSIONS

The following are the conclusions.

At 25 % fly ash and optimum SWA of 12%, for a 28 day curing period, the optimum UCS is 994kPa.

- At 25 % fly ash and optimum SWA of 12%, the optimum CBR is 6.7 %.
- At 15 % fly ash, 7% strain the optimum compressive strength is 398kPa.
- At 15 % fly ash and optimum SWA of 12%, for a 28 day curing period, the optimum UCS is 604 kPa.
- At 30 % fly ash, 8% strain the optimum compressive strength is 497kPa.
- At 0 % fly ash and optimum SWA of 12%, for a 28 day curing period, the optimum UCS is 501 kPa.
- Sudeep Sapkota, Madhukar Dhingra & S. Jayalekshmi, Review on Soil Stabilization Techniques, International Journal of Civil Engineering(IJCE), Volume 3, Issue 3, April-May 2014, pp. 63-78

LIMITATIONS OF THIS STUDY

The results of this paper are limited to the materials tested in this study. Therefore, the results of the study must not be used for any design or construction. More materials need to be tested to increase the scope of this study.

Table 1: Constituents of Fly Ash

Constituents	%
SiO_2	56.0
Al_2O_3	21.0
Fe_2O_3	6.5
CaO	12.2
MgO	3.6
Alkali	1.1
SO_3	1.6
Heavy Metals	trace

Table 2: Chemical Composition of Sorghum Waste Ash

Constituent	%
Silica – SiO_2	50
Alumina – Al_2O_3	8.0
Calcium Oxide – CaO	10
Potassium Oxide - K_2O	10
Ferric Oxide – Fe_2O_3	15
Magnesium oxide - MgO	0.5
Phosphorus Oxide – P_2O_5	2.5

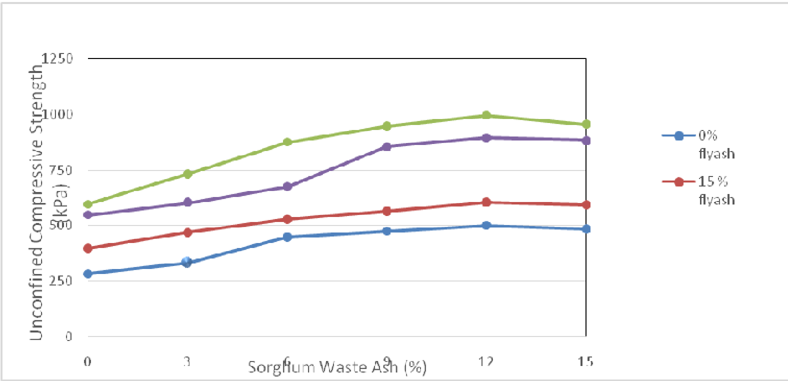

Figure 1: Influence of Sorghum Waste Ash on UCS For the Clay-Flyash Mixture

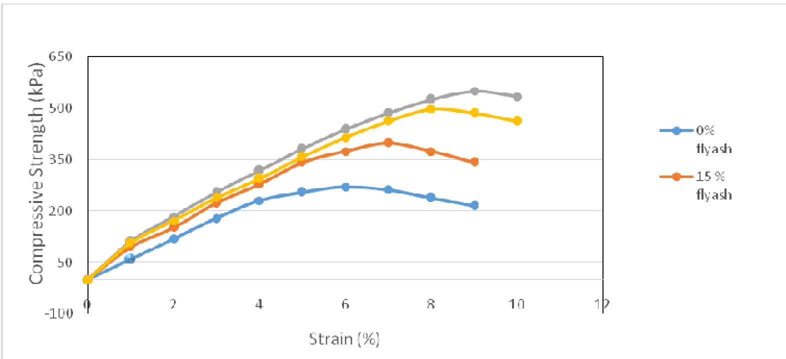

Figure 2: Influence of Fly Ash on the Stress-Strain Behavior of the Soil

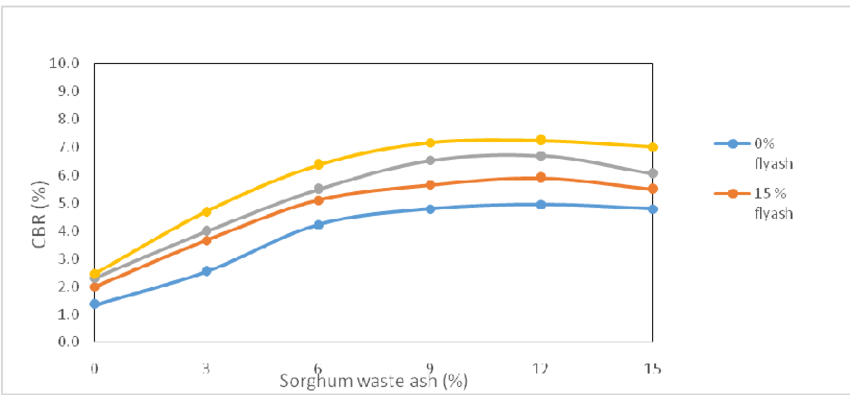

Figure 3: Influence of Sorghum Waste Ash on CBR for the Clay-Flyash Mixture

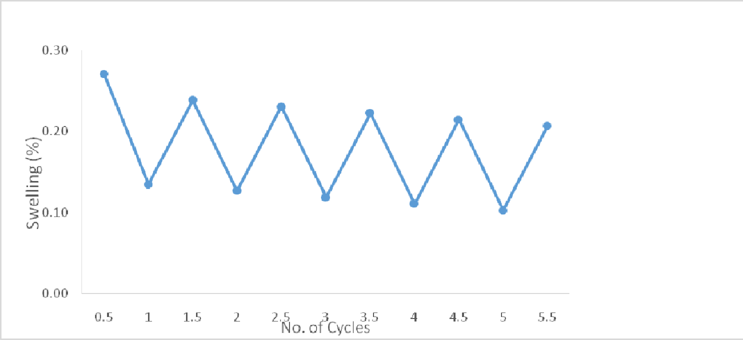

Figure 4: Influence of the Number of Cycles on Swelling of 15% Fly Ash and Sorghum Waste Ash Blend Under Surcharge of 5kpa

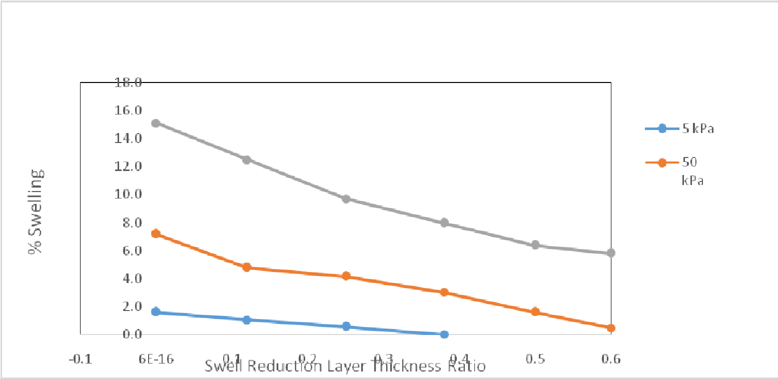

Figure 6: Influence of Swell Reduction Layer Thickness Ratio on the Swell Percentage of Soil for Various Surcharges

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